DYNAMICALLY VARIABLE USER OPERABLE INPUT DEVICE

BACKGROUND

[0001] This invention relates to input devices for processor-based systems.

[0002] Conventional switches (such as, for example, push-button switches, rocker switches and toggle switches) are easy for people to use—it is obvious how to operate them and, when operated, they provide an immediate, visual and tactile indication that actuation has been achieved. One can see and feel them move. For example, push-button switches typically depress until they reach a stop; toggle switches and rocker switches snap between "off" and "on" positions. Conventional switches, however, typically have permanent labels or legends—for example, a number or word printed on a button or key cap. This limits the versatility of the switch. It is difficult to use the same switch for multiple functions because the switch has a single label or legend.

[0003] Touch screens provide the ability to change the legend or label associated with a button image element appearing on the screen. However, unlike conventional push-button switches, touch screens do not provide tactile feedback to the user—i.e., one cannot feel the operation of the switch. Moreover, the time required by the system to process the input can result in a confusing delay in any auditory or visual indication of actuation that the system may be programmed to provide. Also, since most popular computer operating systems have graphical user interfaces that utilize depictions of buttons which are selected by "clicking" on the button image with a mouse or other pointing device, it may not be immediately apparent to new users of touch screen systems whether to push on the screen or find a pointing device to click on the button image.

[0004] What is needed is a device that has the versatility of a touch screen while still being as easy to operate as a conventional, mechanical switch.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] **FIG. 1** is a front elevational view of one embodiment;

[0006] **FIG. 2** is a cross-sectional view of a portion of the embodiment of **FIG. 1** taken generally along line **2-2**;

[0007] **FIG. 3** is a cross-sectional view of another embodiment;

[0008] **FIG. 4** is a cross-sectional view of a third embodiment;

[0009] **FIG. 5** is a cross-sectional view of a fourth embodiment;

[0010] **FIG. 6** is a cross-sectional view of a fifth embodiment;

[0011] **FIG. 7** is a graph showing a characteristic of one hypothetical element which may be employed in some embodiments; and

[0012] **FIG. 8** is a schematic hardware depiction for one embodiment.

DETAILED DESCRIPTION

[0013] Referring to **FIG. 1, a** processor-based system **10** may include an input/output device **16** in accordance with one embodiment. The processor-based system **10** may include a display **12** supported within a chassis **14**. The processor-based system **10** may be, for example, a desktop or laptop computer, a portable device such as a personal digital assistant, or an appliance such as an automatic teller machine. The display **12** may be, for example, a cathode ray tube (CRT) or a liquid crystal display (LCD).

[0014] A plurality of user operable elements **26** may overlie the front lower portion L of display **12**. The upper portion U of display **12** may be used in a conventional manner to display information.

[0015] Each operable element **26** may comprise at least one transparent region **18** for viewing image elements **24** displayed in the lower portion L of the underlying display **12**. The operable elements **26** may include a frame **20** having opaque regions **22**. An opaque region **22** may surround each transparent region **18** to create a visible separation between adjacent transparent regions **18**. The opaque region **22** may also provide a visual separation between lower portion L and upper portion U of display **12** in some embodiments.

[0016] As shown in **FIG. 2**, the operable elements **26** may each be coupled to a switch **36** and/or tactile feedback mechanism **38** such that operation of the operable element **26** actuates the switch **36** and/or the feedback mechanism **38**. The switch **36** or mechanism **38** may be manually operated by depressing the transparent region **18**. The transparent region **18** is part of the frame **20** that moves. The transparent region **18** typically does not move as an independent entity. In the depressed state, shown in dashed lines in **FIG. 2**, the elements **26** extend towards the display **12**, operating the switches **36** and/or mechanisms **38**.

[0017] The switch **36** may be actuated to indicate a user input selection to the processor-based system **10**. Examples of electrical switches include push-button switches, rotary switches and pivoting switches.

[0018] The feedback mechanism **38** may provide auditory and/or tactile feedback to the user to signal switch actuation. The feedback mechanism **38** may be incorporated into switch **36**. Certain types of switches inherently provide tactile and/or auditory feedback upon actuation. An example of auditory feedback is a "click" sound produced upon switch actuation. An example of tactile feedback is an "over-center" action.

[0019] In one hypothetical embodiment, shown in **FIG. 7**, the resistance to actuation is a function of displacement of a feedback mechanism **38**. A force in opposition to actuation of the element **26** builds during the first portion A of such operation and then abruptly decreases with further displacement such that less resistance to further operation may be provided in a second portion B of the actuation operation. In a third portion C, the resistance may build rapidly as the element **26** reaches a displacement limit stop. The function depicted in **FIG. 7** is a non-monotonic function—i.e., a function wherein the dependent variable (force) does not always increase or decrease as the value of the independent variable (displacement) increases or decreases.

[0020] The tactile feedback mechanism **38** may comprise a collapsible rubber dome wherein force is applied to the top